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Editorial

Coherent States in Double Quantum Well Systems

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Coherent states, where a macroscopic system of many quantum particles exhibits properties of a single quantum particle, have been a topic of intense investigations in physics. The formation of such states is usually accompanied by and experimentally indicated by dissipationless transport of mass, charge, or spin.

Excitonic condensation occurs when an electron-hole system develops spontaneous coherence between the electron and hole bands. This effect, predicting the coherent state of electron-hole pairs, has led to a deeper theoretical understanding of condensates with metastable particles. Over the past two decades, this field has seen tremendous experimental developments, starting with the development of spatially separated electron and hole quantum wells, which increased the exciton lifetime by orders of magnitude. The increased exciton lifetime, in turn, has led to a detailed exploration of electrical transport, drag, and photoluminescence properties in such double quantum well systems. These systems have been traditionally fabricated using semiconductor heterojunctions; however, recently, graphene and topological insulators have emerged as promising new candidates as well.

The goal of this special issue is to review the recent theoretical and experimental developments on coherent states in such systems. With the rapid progress in fabrication techniques, it is possible to study coherent states with multiple broken symmetries. Thus, this issue starts with the state of experimental efforts on excitonic condensation in semiconductor quantum wells that are doped or optically pumped. It is followed by theoretical analyses of excitonic condensation in bilayer quantum Hall systems. The last paper extends the discussion on coherent states in graphene double layers.

Acknowledgment

This issue would not have been possible without generous contributions to this new journal from our colleagues. With articles by leading experts in the field of excitonic condensation, we hope that this special issue will form a timely, open-access resource for experts and novice alike.

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